

ECOSYSTEM STATUS INDICATORS

Marine Mammals

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POTENTIAL CAUSES OF DECLINES IN MARINE MAMMALS

Direct Take/Fishery Interactions - Observable interactions between marine mammals and fisheries are generally restricted to direct mortality in fishing gear. In the absence of understanding the effect of individual takes upon the population as a whole, interpretation of the significance of removal of individuals is limited to a simple accounting of the number of individual animals killed. Based on counts of animals reported taken incidentally in fisheries up through 2003 (Angliss and Lodge 2004), none of the marine mammal incidental mortality estimates for Alaskan groundfish fisheries exceeded the potential biological removal (PBRs) (Hill and DeMaster 1999; Table 23). However, it should be noted that a number of stocks of marine mammals are incidentally killed in commercial fisheries activities (Table 23). Killer whales, humpback whales, and Steller sea lions have levels of mortality which may cause some federally-managed commercial fisheries to change categories in the List of Fisheries. While there are many fisheries that overlap within the range of depleted and endangered marine mammal stocks, few overall are observed, and the rate of coverage is low. Reliable estimates of PBRs for a number of stocks (i.e. harbor seals) are limited by the absence of updated population data. As it is acquired, stock assessment data will be used to evaluate the progress of each fishery towards achieving the goal of zero fishery-related mortality and serious injury of marine mammals, as outlined in the Marine Mammal Protection Act (MMPA) (Public Law 103-238, 1994).

Resource Competition - There is both direct and indirect overlap in the species and size of primary prey consumed by marine mammals and targeted in commercial fisheries. For example, adult female northern fur seals consume walleye pollock (*Theragra chalcogramma*) in adult and juvenile stages (Sinclair et al., 1994). Adult and juvenile walleye Pollock are both consumed by adult and juvenile Steller sea lions as well (Merrick and Calkins 1996, Sinclair and Zeppelin 2002, Zeppelin et al. 2004). Thus, much of the recent effort to understand the decline among marine mammals has focused on their diet and foraging behavior. The hypothesis is that either direct or indirect competition for food with commercial fisheries may limit the ability of apex predators to obtain sufficient prey for growth, reproduction, and survival (NRC 1996). In the case of Steller sea lions, direct competition with groundfish fisheries may occur for walleye pollock (*Theragra chalcogramma*), Atka mackerel (*Pleurogrammus monopterygius*), salmon (Salmonidae), and Pacific cod (*Gadus macrocephalus*) (Calkins and Pitcher 1982, Sinclair and Zeppelin 2002, Zeppelin et al. 2004). For northern fur seals, adult walleye pollock and salmon consumption (Kajimura 1984, Perez and Bigg 1986, Lowry 1982, Sinclair et al. 1994, 1996) is in direct conflict with commercial harvests.

Competition may also exist where marine mammal foraging areas and commercial fishing zones overlap. Female northern fur seals from the Pribilof Islands forage extensively at distances greater than 81 nm (150 km) from the rookery (Robson 2001), placing them within range of commercial groundfish vessels displaced by Steller sea lion conservation zone restrictions.

Indirect Competition - More difficult to identify are the indirect effects of competition between marine mammals and fisheries for prey resources. Such interactions may limit foraging success through

localized depletion (Lowe and Fritz 1996), destabilization of prey assemblages (Freon et al. 1992, Nunnallee 1991, Laevastu and Favorite 1988), or disturbance of the predator itself. Compounding the problem of identifying competitive interactions is the fact that biological effects of fisheries may be indistinguishable from changes in community structure or prey availability that might occur naturally.

Whereas the overall abundance of prey across the entire Bering Sea or GOA may not be affected by fishing activity, reduction in local abundance, or dispersion of schools could be more energetically costly to foraging marine mammals. Thus, the timing and location of fisheries, relative to foraging patterns of marine mammals may prove to be a more relevant management concern than total removals.

Environmental and climatic change - The relative significance and combined impact of fisheries perturbations with broad, regional events such as climatic shifts is uncertain, but given the potential importance of localized prey availability for foraging marine mammals, warrants close consideration.

Most scientists agree that the 1976/77 regime shift dramatically changed environmental conditions in the BSAI and GOA (Benson and Trites 2000). However, there is considerable disagreement on how and to what degree these environmental factors may have affected both fish and marine mammal populations. Some authors suggest that the regime shift changed the composition of the fish community resulting in reduction of prey diversity in marine mammal diets (Sinclair 1988, Sinclair et al. 1994, Piatt and Anderson 1996, Merrick and Calkins 1996). Some suggest the overall biomass of fish was reduced by about 50 percent (Merrick et al. 1995, Piatt and Anderson 1996). Others suggest that the regime shift favored some species over others, in part because of a few years of very large recruitment and overall increased biomass (Beamish 1993, Hollowed and Wooster 1995, Wyllie-Echeverria and Wooster 1998).

Hunt et al. (2002) proposed that the pelagic ecosystem in the southeastern Bering Sea alternates between bottom-up control in cold regimes and top-down control in warm regimes. In their proposed Oscillating Control Hypothesis, Hunt et al. (2002) hypothesized that when cold or warm conditions span decades, the survival and recruitment of piscivorous vs. planktivorous fishes are variably affected (Hunt et al. 2002) along with the capacity of fish populations, (and arguably, apex predator populations) to withstand commercial fishing pressures.

Shima et al. (2000) looked at the GOA and three other ecosystems where pinniped populations, marked environmental oscillations, and extensive commercial fishing activity all occur. Among pinnipeds in the four ecosystems, only GOA Steller sea lions were decreasing in abundance. Shima et al. (2000) hypothesized that the larger size and restricted foraging habitat of Steller sea lions, especially for juveniles that forage mostly in the upper water column close to land, may make them more vulnerable than other pinnipeds to changes in prey availability, and spatial and temporal changes in prey, especially during the critical winter time period.